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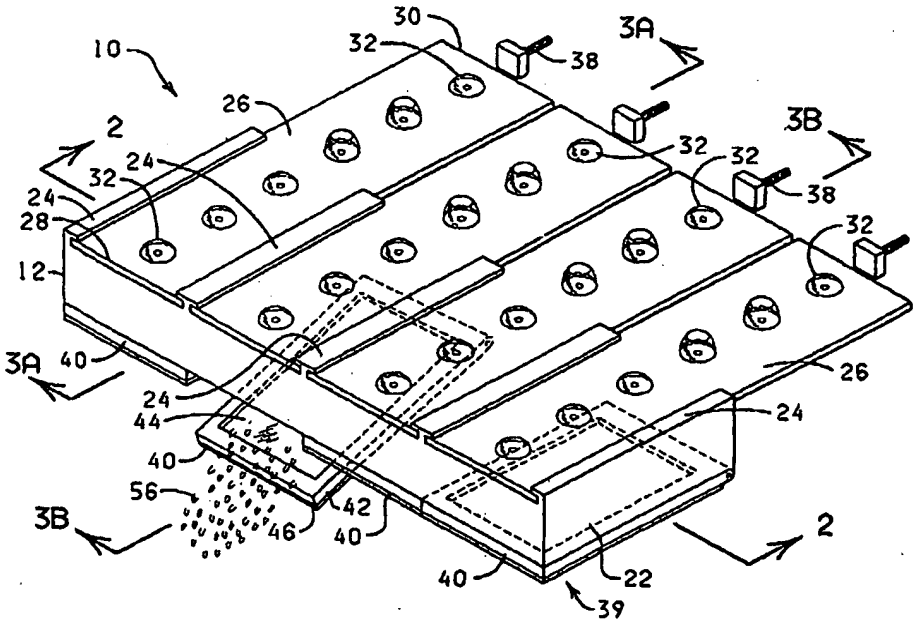

(57) Abstract: An automated in situ heat induced antigen recovery and staining method and apparatus (10) for treating a plurality of microscope slides (44).

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INTERNATIONAL SEARCH REPORT

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A. CLASSIFICATION OF SUBJECT MATTER

IPC(7) :G01N 33/53
US CL :436/46

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

U.S. : 436/46-49,164,166,169;422/56,58,61,63-67

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 5,839,091 A (RHETT et al) 17 November 1998, see the entire document	1-27
X	US 3,645,690 A (ROCHTE et al) 29 February 1972, see the entire document	1-27

☐ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

*	Special categories of cited documents:	"T"	later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"A"	document defining the general state of the art which is not considered to be of particular relevance	"X"	document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"E"	earlier document published on or after the international filing date	"Y"	document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"L"	document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)	"&"	document member of the same patent family
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ANTIGEN RECOVERY AND/OR STAINING APPARATUS AND METHOD

CROSS-REFERENCE TO RELATED APPLICATIONS

The present application claims the benefit of U.S. Provisional Application Serial No. 60/142,789, filed July 8, 1999, which is hereby incorporated by reference herein in its entirety.

STATEMENT REGARDING FEDERALLY SPONSORED RESEARCH OR DEVELOPMENT

Not Applicable

BACKGROUND

The present invention is related to the field of treating samples on microscope slides and more specifically to the field of heat induced antigen recovery and staining.

Antigen recovery, also known as antigen unmasking, antigen epitope unmasking, antigen retrieval or heat induced epitope recovery (HIER) is a process in which biological samples (e.g., cells, tissues, blood, fluids) are treated under heat with a series of aqueous or non-aqueous reagents and buffers (e.g., citrate, EDTA, and urea) for the purpose of exposing the presence of specific types of antigens or biochemical features in the biological samples. HIER is regarded as a pre-treatment procedure to be performed prior to the beginning of a specific staining protocol to identify cellular components.

Biological samples must be preserved after removal from the body. This preservation process, known as fixation, kills and localizes the biological material. One of the most common fixatives used widely in the preservation of biological materials is formalin, a 10% aqueous solution of formaldehyde. This fixative, along with other widely utilized fixatives, produces a cross-linking network around specific sites in the biological material. These sites are known as antigens, and during the fixation process become "masked," by the fixative and thus "invisible" to detection by certain stains. HIER is used as a pre-treatment process to "unmask," "retrieve" or "recover." This process is usually conducted on formalin fixed paraffin embedded tissue sections or cellular preparations mounted on microscope slides.

U.S. Patent No. 5,244,787 teaches a process of antigen retrieval wherein one or more slides are placed in an aqueous solution within a microwave oven and heated to boiling or near-boiling temperatures. These slides are all treated together in a rack that has been placed in a bath of the solution. The slides are near boiling temperatures for 5-30 minutes, generally around 10 minutes. Due to excessive evaporation from the bath, the patent teaches that the solution should not drop below the biological sample on the slide because drying out of the sample is deleterious. This process further teaches that after boiling or near-boiling for several minutes, usually 5 minutes, one may have to add more solution to the container to prevent the

solution from excessive evaporation and subsequent exposure of the samples on the slides. After the addition of more liquid, the process is continued until the desired time is completed. The disclosure of 5,244,787 is limited to the use of a microwave oven as the source of heating. More recent advances, which have been published, include the use of different types of heating devices such as electric pressure cookers, electric steamers, electric conduction heating surfaces utilizing pressure cookers, steamers, and also steam driving autoclaves (J. of Pathology, 179:347-352, 1996; Biotechnic & Histochemistry, 71(5):263-270, 1996; Biotechnic & Histochemistry, 71(4):190-195, 1996; J. of Histochemistry & Cytochemistry, 45(3): 327-342, 1997).

Although these published methodologies treat the biological sample with different types of solutions and with varying types of chemicals and at different pH's, all teach that all slides are treated together in a bath of the heated solution. After the slides have cooled for a period of time, they are removed from the heating device and they are transferred to another apparatus where they are manually or automatically stained using various reagents. This pre-treatment process of heating and removing the slides from the heating device for staining in a separated apparatus is highly cumbersome and inefficient. The only automated HIER or antigen retrieval instrument available is the BIOGENEX i1000. This instrument, however, still employs the use of the known technology of treating the slides as a group in a container filled with heated solutions. A technician must still

remove the slides from the antigen retrieval (heating) instrument and place them in an automated stainer instrument to complete the required staining protocol.

As noted herein, no currently available automated or semi-automated staining instruments specifically teach the ability to heat an aqueous or non-aqueous liquid for the unmasking of antigens. The instruments that do automated or semi-automated staining limit their scope to that task alone, and don't address the task of HIER or antigen retrieval pre-treatments. U.S. Patents 5,073,504 and 4,847,208 teach use of a chamber for enclosing and staining a microscope slide but neither teaches use of a heating device to boil a liquid and the user must add the primary antibody manually through a hinged door on top of the chamber. U.S. Patents 4,777,020; 4,798,706; and 4,801,431 teach use of a vertical staining "capillary gap" methodology wherein two special slides placed front to front causing an air gap through which liquids are drawn by capillary movement. This gap can only hold a small volume (approx. 300 microliters) of liquid. If heated to near boiling conditions the liquid would evaporate through all four open sides, immediately causing the biological sample to dry. This end result is true also for another capillary gap instrument, shown in U.S. Patent 5,804,141. U.S. Patents 5,595,707; 5,654,200; 5,654,199, 5,595,707; and 5,650,327 teach reducing evaporative loss by utilizing an oil layer on top of the aqueous layer. This is somewhat effective in reducing the amount of evaporative loss at 37°C but the volume

of the aqueous layer (approx. 300 microliters) is again minimal, and if heated to boiling, would cause the aqueous layer to dry out leaving only the oil layer present thus damaging the biological sample unless more aqueous reagent was applied during the treatment process. U.S. Patent 5,425,918 also teaches use of small amounts of liquids that are sprayed on the slide and can only heat the slide to 37°C. U.S. Patents 5,645,144 and 5,947,167 teach use of an open top chamber present around the slide and use a rotating cover above the slides to reduce evaporation. There is no teaching of high temperature heating of a liquid for a substantial amount of time. Further, even if one would increase the temperature of the slide, the loosely rotating top of the chamber would allow so much evaporative loss that the solution would never reach boiling or near boiling temperatures, nor would it maintain the boiling conditions for 10 minutes or longer. U.S. Patent 5,645,114 teaches use of small volumes of liquids (up to 500 microliters) and has no ability to stop evaporative loss if the slide temperature reaches boiling conditions.

As a result, none of these systems could hold sufficient liquid on top of a slide (e.g., 4ml) and are enclosed in a chamber which is properly vented to minimize the energy loss from evaporation to cause sufficient heating to boil the liquid on the slide for the length of time generally required to cause antigen unmasking (e.g., 10-30 minutes).

There remains a need for an apparatus which can perform the task of HIER with subsequent staining treatment without the need of switching the slides from one apparatus to another and wherein the treatment of all microscope slides can occur simultaneously thereby increasing efficiency. Of the automated stainers available today, there is not one instrument that has the ability to overcome the inherent problems of heating an aqueous or non-aqueous solution at a sufficient volume without the undesirable effect of evaporative heat loss and subsequent volume decrease of the solution. The negative effects of evaporation are significant. The ability of a liquid to reach boiling or near boiling temperature on a microscope slide is dependent on the containment and control of the steam or vapor generated during the heating process. It is the object of the invention contemplated herein to provide a completely automated HIER apparatus which can recover antigens with multiple types of recovery buffers simultaneously, each specific to its respective microscope slide and which can also be used to stain the microscope slides as well.

DESCRIPTION OF THE DRAWINGS

Figure 1 is a perspective view of an apparatus of the invention (shown without a pressing element for crushing a reagent capsule).

Figure 2 is a cross-sectional view of the apparatus of Figure 1 (shown with a pressing element for crushing a reagent capsule).

Figure 3A is a cross-sectional view of the apparatus of Figure 1 (shown with a reaction compartment having a raised slide support surface) taken through line 3A-3A.

Figure 3B is a cross-sectional view of the apparatus of Figure 1 (shown with a reaction compartment having a lowered slide support surface) taken through line 3B-3B.

Figure 4 is a cross-sectional view of an alternative embodiment of the apparatus of the present invention having an alternate type of slide support surface.

Figure 5 is a perspective view of a reagent strip of the present invention.

Figure 6 is a cross-sectional view of the reagent strip of Figure 5 taken through the line 6-6.

Figure 7 is an elevational view of a modular apparatus containing a plurality of the apparatus of Figure 1.

Figure 8 is a flow chart showing a preferred sequence of steps in the method of the present invention.

DETAILED DESCRIPTION OF THE INVENTION

The present invention is directed to an automated method and apparatus for treating biological samples on microscope slides for unmasking ("retrieving" or "recovering") epitopes or antigens of the biological samples and then staining or otherwise treating

the biological samples. The automated apparatus comprises an array of individual reaction compartments, each of which is used to treat a single microscope slide (also referred to herein as a "slide"), wherein each reaction compartment preferably can function and can be controlled independently of the other reaction compartments in the array. Each reaction compartment in the array comprises a support element comprising a surface upon which a microscope slide can be supported and positioned adjacent or inserted into the compartment for treatment with a reagent. The support element further comprises, in a preferred embodiment, a conduction type heating element for heating the microscope slide to a predetermined treatment temperature when desired. The support element with the microscope slide thereon can be raised into or adjacent the reaction compartment for treatment of the microscope slide, or lowered or removed from the reaction compartment for placement of a microscope slide onto or removed from the support surface or for removal of a reagent or rinsing solution from the microscope slide during the treatment process.

Reagents, such as antibodies, enzymes, rinse buffers, antigen recovery buffers, or stains, are contained in an individualized reagent dispensing strip which is specific for each microscope slide to be treated. Since each microscope slide and reaction compartment is generally provided with its own reagent dispensing strip, each microscope slide can be treated independently with a different set of reagents (a particular

treatment protocol) while being treated simultaneously with other microscope slides. Similarly, in an especially preferred embodiment of the invention, each microscope slide can be heated separately, as well as treated with a different treatment protocol. The apparatus of the present invention therefore comprises, in a preferred embodiment, a plurality of individualized reaction compartments in a chamber which can be substantially closed for minimizing evaporation during heating. A microscope slide can be supported in each reaction compartment, and each microscope slide can be heated separately therein. A reagent dispensing strip containing a plurality of individually contained reagents (reagent "bubbles", "blisters" or "capsules") is positioned upon an upper portion of each reaction compartment, and at an appropriate time, a reagent from each reagent dispensing strip is expelled from a reagent capsule under compression and is thereby applied to the biological sample on the microscope slide. Or, a reagent, such as an antigen recovery buffer can be introduced via a separate dispenser. The term "reagent" is defined herein to include any type of fluid material that may be applied to the biological material on the microscope slide, including antibodies, stains, enzymes, buffers, rinses, or washes, or any other material applied in the process of antigen recovery or treating the biological material on the microscope slide to be viewed under the microscope.

During an antigen recovery step, the microscope slide, sample, and antigen recovery buffer thereon are heated to an

appropriate temperature for a predetermined duration to cause the antigen recovery buffer to react with the sample on the microscope slide, after which the antigen recovery buffer is removed from the microscope slide, preferably by washing or flooding the microscope slide or chamber containing the microscope slide with a rinse buffer and allowing the rinse buffer to drain off by gravity or by blowing the solution off the microscope slide using pressurized air. Each microscope slide may be treated in the same manner, or may be treated with different reagents using a different treatment protocol, preferably simultaneously, yet independently.

When a reagent is provided via a reagent dispensing strip, the apparatus is preferably equipped with a drive mechanism for causing the reagent dispensing strip to be advanced in a forward direction wherein each reagent capsule in succession is positioned above an aperture in the compartment through which the reagent in the capsule is delivered. The reagent dispensing strip may be advanced using rollers positioned along the upper end of the compartment or a pushing mechanism which pushes upon the rear end of the reagent dispensing strip. The reagent in the reagent capsule of the reagent dispensing strip is to be applied to the microscope slide by a pressing mechanism which, in a preferred version, compresses and thereby crushes the reagent capsule and causes the reagent to be expelled and deposited directly onto the microscope slide.

In a preferred method of the present invention, a plurality of microscope slides, each having thereon a sample to be treated, is provided. Each microscope slide is positioned upon a support element which is then moved into an application position. A plurality of reagent dispensing strips is provided, one for each microscope slide to be treated. Each microscope slide is subjected to an antigen recovery step then is treated by applying a reagent from its corresponding reagent dispensing strip. Each microscope slide can be handled differently, if desired, during the treatment cycle. After a predetermined duration, the microscope slide and support element is moved to a removal position wherein the reagent is removed, preferably in between reagent applications, by treatment with a rinsing solution to remove the reagent prior to further treatment. Each microscope slide can be treated according to the treatment protocol specific to that sample or that particular microscope slide. All microscope slides may be treated using the same protocol, or one or more, or all, of the microscope slides may be treated using a different protocol.

An example of a treatment protocol comprises:

1) antigen recovery, approximately 10 minutes at approximately 98°C,
2) cool, approximately 20 minutes,
3) rinse buffer,
4) primary antibody, approximately 30 minutes,
5) rinse,
6) biotinylated linking antibody, approximately 10 minutes,

7) rinse buffer,

8) peroxidase labeled streptavidin label,

9) rinse buffer,

10) 3,3'-diaminobenzidine chromogen,

11) rinse buffer,

12) chromogen enhancer,

13) rinse buffer, and

14) counter stain.

A variety of other treatment protocols are well known to those of ordinary skill in the art and further discussion of them herein is not deemed necessary. Each microscope slide, if necessary, may be heated prior to application of the reagent, if necessary, then may be cooled as the reagent is removed, then reheated, if necessary, prior to or after addition of the next reagent. The entire process is run automatically once the microscope slide is disposed onto the support element, and the reagent dispensing strip is positioned upon the upper side of the reaction compartment.

Turning now to the drawings, a specific embodiment of the apparatus of the present invention is shown in Figures 1-6. Although Figures 1-6 show a preferred version of the invention, it will be understood that the embodiment shown in Figures 1-6 is but one of many possible versions of the apparatus enabled herein which will come to the mind of a person of ordinary skill in the art.

Shown in Figure 1, and designated therein by the general reference numeral 10 is an antigen recovery and staining apparatus constructed in accordance with the present invention. The antigen recovery and staining apparatus 10 comprises a treatment chamber 12 which further comprises a plurality of reaction compartments 14 (see Figures 2 - 4). Preferably the treatment chamber 12 generally comprises from about 10 to about 20 reaction compartments 14 but may contain more or fewer. Each reaction compartment 14, when enclosed, minimizes evaporation of a reagent solution when a microscope slide is exposed to high temperature pretreatment conditions. Each reaction compartment 14 has an upper side 16 having an opening 18 therein, a lower side 20, and a pair of sidewalls 22 which extend from the rear end 23a of the treatment chamber 12 to the front end 23b of the treatment chamber 12. Positioned above each reaction compartment 14 is a reagent dispensing strip holder 24 for holding and guiding a reagent dispensing strip 26 (see Figures 5 and 6). Each reagent dispensing strip 26 has a front end 28 and a rear end 30 and a plurality of capsules 32 made of a crushable plastic material such as polyethylene or another suitable material (e.g., polypropylene or polystyrene) and which may include one or more multiple capsules 32a. The size of each capsule 32 or multiple capsule 32a may be adjusted to accommodate the amount of reagent which is desired to be applied to a microscope slide 44. Each capsule 32 or multiple capsule 32a contains a reagent or treatment solution which is intended to be applied to a

biological material on the microscope slide 44. Multiple capsule 32a is useful in a method wherein two or more reagents must be contained separately before being applied to the microscope slide 44. When the multiple capsule 32a is crushed by the pressing mechanism 36, two or more reagents contained within the capsule 32a are combined and simultaneously applied to the microscope slide 44.

Other embodiments of the reagent dispensing strip 26 and the reagent capsule 32 and multiple capsule 32a will readily be apparent to one of ordinarily skill in the art. For example, each reagent dispensing strip 26 may comprise a one or more "blank" spaces for insertion of individualized capsules 32 by a user. Below each capsule 32 or multiple capsule 32a is an aperture or weak area 34 in the reagent dispensing strip 26 through which the reagent in the capsule 32 or multiple capsules 32 can be forced by a pressing mechanism 36. The "blank" space or space left by the puncturing of a capsule 32 or 32a, or vents in the reagent dispensing strip 26 may function to release pressure, steam or vapors produced during the treatment process. The reagent dispensing strip 26 is advanced in a direction 37 toward the front end 23b of the treatment chamber 12 by a reagent strip drive mechanism 38 driven, for example, by an electric motor which in Figures 1, 3A and 3B is shown as a pushing mechanism comprising a threaded shaft, but which may instead by a mechanism (not shown) comprising rollers which drive, draw or "pull" the reagent strip holder 24 in a forward direction 37.

Each reaction compartment 14 further comprises at its lower side 20 a slide support assembly 39 comprising a plurality of slide support elements 40 each having a slide tray 42 upon which the microscope slide 44 can be positioned and held for treatment. With the microscope slide 44 disposed on the slide support element 40, the slide support element 40 and the microscope slide 44 are positioned in an application position to fit adjacent the lower side 20 of the reaction compartment 14, thereby constituting an openable bottom of the reaction compartment 14. The slide support element 40 further has a heating element 46 incorporated therein for heating the microscope slide 44 as discussed elsewhere herein. In one embodiment, the slide support element 40 has a hinge 48 for enabling the slide support element 40 to be moved (raised) into an application position (Figure 3A) and therefrom lowered into an opened position (see Figure 3B). Alternatively, the slide support element 40 may be raised and lowered into position by another mechanism, such as a stepper motor 58 and screw drive 59 mechanism (Figure 4). Each reaction compartment 14 further comprises a manifold 50 which comprises, in a preferred embodiment, a plurality of reagent dispensing ports or elements including, for example but not limited to , an antigen recovery buffer dispenser 51 connected via an antigen recovery buffer supply line 51a to an antigen recovery buffer supply (not shown), a rinse buffer dispenser 52 connected via a rinse buffer supply line 52a to a rinse buffer supply (not shown) and an air pressure nozzle 54 connected via an air line 54a to

an air supply (not shown). The antigen recovery buffer dispenser 51 applies an antigen recovery buffer to the microscope slide 44 for the antigen recovery treatment step prior to staining or other preparation of the biological material on the microscope slide 44. The rinse buffer dispenser 52 applies a rinse buffer 56 to the microscope slide 44 to rinse a reagent from the microscope slide 44. The air pressure nozzle 54 functions to clear away a rinse buffer 56 from the microscope slide 44. Dispensers 51 and 52 may be used to dispense other reagents, and may constitute more than, or fewer than, the dispensers shown in Figures 2, 3A, 3B, and 4. The microscope slide 44 is generally disposed in a removal position for facilitating removal of the rinse buffer 56 as shown in Figures 1 and 3B. Each slide support element 40, in a preferred embodiment, can be heated or moved independently of any other slide support element 40, although one of ordinary skill in the art can envision that the slide support elements 40 may be designed to operate in concert, i.e., simultaneously.

The antigen recovery and staining apparatus 10 can be controlled automatically wherein predetermined sequences and operations are carried out using various electromechanical systems which are not shown but which are well known to those of ordinary skill in the art. For example, each of the steps of raising into a treatment position and lowering into a removal position each of the slide support elements 40, applying an antigen recovery buffer, advancing each reagent dispensing strip

26, compressing each capsule 32 or 32a of the reagent dispensing strip 26, heating each microscope slide 44 on the slide support surface 40, applying a rinse buffer 56 to the microscope slide 44, removing the rinse buffer 56 or other reagent from the microscope slide 44, and treating each microscope slide 44 independently can be automatically controlled and programed using programming methods and devices well known in the art. Because each reaction compartment 14 and slide support element 40 can be controlled independently, a microscope slide 44 can even be removed or inserted even while other reaction compartments 14 are in operation.

Preferably, a microprocessor, not shown, controls the antigen recovery and staining apparatus 10. That is, an operator programs the microprocessor with information such as which reaction compartments 14 are to be used and to what temperature each is to be heated and at which steps, then programs the particular treatment protocol to be performed on the sample on each microscope slide 44 on each slide support element 40. Variables in these protocols can include the particular type of reagent dispensing strip 26 to be used, the time that each reagent or treatment solution on the reagent dispensing strip 26 will be allowed to react with the sample on the microscope slide 44, whether the microscope slide 44 will be heated, and if so to what temperature and for how long, and the manner in which the microscope slide 44 will be rinsed, for example. Other variables not listed herein may also be programmed.

The invention may further comprise a modular apparatus 60 comprising a plurality of antigen recovery and staining apparatuses 10 each serving as an individual module in the modular apparatus 60. The individual modules can be "stacked" together for example, as shown in Figure 7, or may be oriented in any other desirable manner.

Shown in Figure 8 is a schematic drawing which describes the preferred method of the present invention. In the first step, a microscope slide 44 which has a sample disposed thereon is provided, and is disposed onto a slide support element 40 which is moved into an application or treatment position adjacent or against the reaction compartment 14. If a plurality of microscope slides 44 are supplied, each microscope slide 44 is disposed on a separate microscope slide support element 40 and the microscope slides 44 are moved independently or simultaneously into an application position.

Once in the application position, an antigen recovery buffer is initially applied to the sample on the microscope slide 44. Microscope slide 44 is then heated to a desired, predetermined temperature, for example from about 140°C to about 160°C whereby the antigen recovery buffer is heated to a temperature of from about 90°C to about 100°C, for example. The microscope slide 44 is allowed to react with the reagent for a predetermined length of time, for example, about 10 to about 30 minutes, preferably at about 95° to about 98°C. Venting of steam may occur through small holes (not shown) in the reagent strip 26 or elsewhere in the reaction compartment 14.

It is necessary to add additional antigen recovery buffer during this step. After the reaction period is over, the slide support element 40 and the microscope slide 44 thereon are moved (lowered or dropped) to a removal position, if necessary, where the antigen recovery buffer is removed from the microscope slide 44, for example, by applying a rinsing solution or buffer to the microscope slide 44 or by gravity or by pressurized air. A rinse solution or buffer may be applied and removed more than once for treatment or for removal of a particular reagent before or after lowering the microscope slide 44 to the removal position. It may be desirable to add rinse buffer to the microscope slide 44 to cool the microscope slide 44 prior to lowering the microscope slide 44 to the removal position, for example, by adding rinse buffer 56 to the antigen recovery buffer before the microscope slide 44 is moved to the application position. After the microscope slide 44 has been treated for antigen recovery, another reagent can then be applied for treatment of the sample on the microscope slide 44. In this step, the microscope slide 44 and slide support element 40 are then returned to the application position, a reagent is applied, and is then removed after the treatment period. The series of steps may be repeated. When the treatment of the sample is completed, the microscope slide 44 is removed from the slide support element 40 for further treatment or analysis apart from the antigen recovery and staining apparatus 10.

Changes may be made in the construction and the operation of the various components, elements and assemblies described herein or in the steps or the sequence of steps of the methods described herein without departing from the scope of the invention as defined in the following claims.

The invention illustratively disclosed herein suitably may be practiced in the absence of any element which is not specifically disclosed herein.

The following claims are entitled to the broadest possible scope consistent with this application. The claims shall not necessarily be limited to the preferred embodiments or to the embodiments shown in the examples

What is claimed is:

1. A method of treating a microscope slide, comprising:

(a) providing a plurality of microscope slides, each having a treatment sample disposed thereon;

(b) disposing each microscope slide on a slide support element of a slide support assembly, each slide support element movable to an application position and to a removal position;

(c) providing a plurality of reagent dispensing strips, each reagent dispensing strip comprising at least one reagent capsule having a reagent therein for treating one of said microscope slides, each reagent dispensing strip corresponding to a particular microscope slide;

(d) moving each slide support element and the microscope slide thereon to a closed application position;

(e) treating each microscope slide by applying a reagent from each reagent dispensing strip or via another reagent dispensing element to the microscope slide corresponding thereto in the application position;

(f) moving each slide support element and microscope slide thereon to the removal position after a predetermined treatment duration and removing the reagent from each microscope slide; and

(g) repeating steps (d) - (f) until each of the microscope slides has been treated using a predetermined treatment protocol.

2. The method of claim 1 wherein in the step of removing the reagent, the reagent is removed by pressurized air.

3. The method of claim 1 wherein in the step of removing the reagent, the reagent is removed by vacuum or aspiration.

4. The method of claim 1 wherein the step of removing the reagent from each microscope slide includes rinsing the microscope slide with a rinse solution.

5. The method of claim 1 comprising an initial treatment step of applying an antigen recovery buffer to the microscope slide and heating each microscope slide to a temperature adequate to induce antigen recovery of the treatment sample on the microscope slide.

6. The method of claim 1 wherein at least one of the microscope slides of the plurality of microscope slides is treated using a different treatment protocol than at least one other microscope slide of the plurality of microscope slides.

7. A method of treating a microscope slide for in situ antigen recovery and staining, comprising:

(a) providing a plurality of microscope slides, each having a treatment sample disposed thereon;

(b) disposing each microscope slide on a slide support element of a slide support assembly, each slide support element movable to an application position and to a removal position;

(c) providing a plurality of reagent dispensing strips, each reagent dispensing strip comprising at least one reagent capsule having a reagent therein for treating one of said microscope slides, each reagent dispensing strip corresponding to a particular microscope slide;

(d) moving each slide support element and the microscope slide thereon to a closed application position;

(e) applying an antigen recovery buffer to each microscope slide and heating each microscope slide to a temperature adequate to induce antigen recovery of the treatment sample on the microscope slide;

(f) moving each slide support element and microscope slide thereon to the removal position and removing the antigen recovering buffer from each microscope slide thereby treated;

(g) returning each slide support element and microscope slide thereon to the application position;

(h) treating each microscope slide by applying another reagent from each reagent dispensing strip or via another reagent dispensing element to the microscope slide corresponding thereto in the application position;

(i) moving each slide support element and microscope slide thereon to the removal position after a predetermined treatment duration and removing the reagent from each microscope slide; and

(j) repeating steps (g) - (i) until each of the microscope slides has been treated using a predetermined treatment protocol.

8. The method of claim 7 wherein in the step of applying an antigen recovery buffer occurs at a temperature of between about 95°C and about 98°C for about 10 to about 20 minutes and wherein antigen recovery occurs without the addition of antigen recovery buffer added while the slide is being heated at the temperature for antigen recovery.

9. The method of claim 8 wherein the antigen recovery buffer on the microscope slide is heated to a temperature of about 98°C for about 10 minutes.

10. The method of claim 7 wherein in the step of removing the reagent or antigen recovery buffer, the reagent or antigen recover buffer is removed by pressurized air.

11. The method of claim 7 wherein in the step of removing the reagent or antigen recovery buffer, the reagent or antigen recovery buffer is removed by vacuum or aspiration.

12. The method of claim 7 wherein the step of removing the reagent or antigen recovery buffer from each microscope slide includes rinsing the microscope slide with a rinse solution.

13. The method of claim 7 wherein at least one of the microscope slides of the plurality of microscope slides is treated using a different treatment protocol than at least one other microscope slide of the plurality of microscope slides.

14. The method of claim 7 wherein step (e) occurs simultaneously to each of the microscope slides in the plurality of microscope slides.

15. An in situ antigen recovery and staining apparatus for treating tissue samples on microscope slides, comprising:

a slide support assembly comprising a plurality of slide support elements for supporting a plurality of microscope slides;

a heating element incorporated into or adjacent each slide support element for heating a microscope slide on the slide support element; and

a treatment chamber comprising a plurality of closeable reaction compartments, each reaction compartment having an openable bottom comprising a portion of the slide support element and an upper side for supporting a reagent dispensing strip and the upper side having an upper opening through which a reagent can be delivered from the reagent dispensing strip into an inner space of the reaction compartment.

16. The apparatus of claim 15 further comprising:

a drive mechanism for advancing each reagent dispensing strip into a dispensing position;

a press assembly comprising a plurality of pressing mechanisms for puncturing a reagent capsule on the reagent dispensing strip for delivering a reagent from the reagent capsule through the upper opening of the reaction compartment into the reaction compartment below the reagent dispensing strip;

a dispenser, for dispensing a quantity of a rinse solution into each reaction compartment; and

a nozzle for delivering a stream of pressurized air into each reaction compartment.

17. The apparatus of claim 16 further comprising a port for dispensing an antigen recovery buffer into the reaction compartment.

18. The apparatus of claim 16 wherein the drive mechanism can operate to independently advance each reagent dispensing strip.

19. The apparatus of claim 15 wherein the heating element can operate to independently heat each microscope slide disposed on the slide support assembly.

20. The apparatus of claim 16 wherein the press assembly can operate such that each pressing mechanism can operate independently.

21. The apparatus of claim 15 wherein each slide support element is independently movable.

22. The apparatus of claim 16 wherein each dispenser can operate independently.

23. The apparatus of claim 16 where each nozzle can operate independently.

24. The apparatus of claim 15 wherein each slide support element is movable upwardly and downwardly.

25. A modular treatment apparatus comprising a plurality of the treatment in situ antigen recovery and staining apparatuses of claim 15.

26. A method of treating a microscope slide, comprising:

(a) disposing a microscope slide on a slide support element of a slide support assembly; and

(b) treating the microscope slide by applying a reagent to the microscope slide.

27. A method of treating a microscope slide, comprising:

(a) disposing a microscope slide on a support element of a slide support assembly;

(b) applying an antigen recovery buffer to the microscope slide and heating the microscope slide; and

(c) treating the microscope slide by applying another reagent.

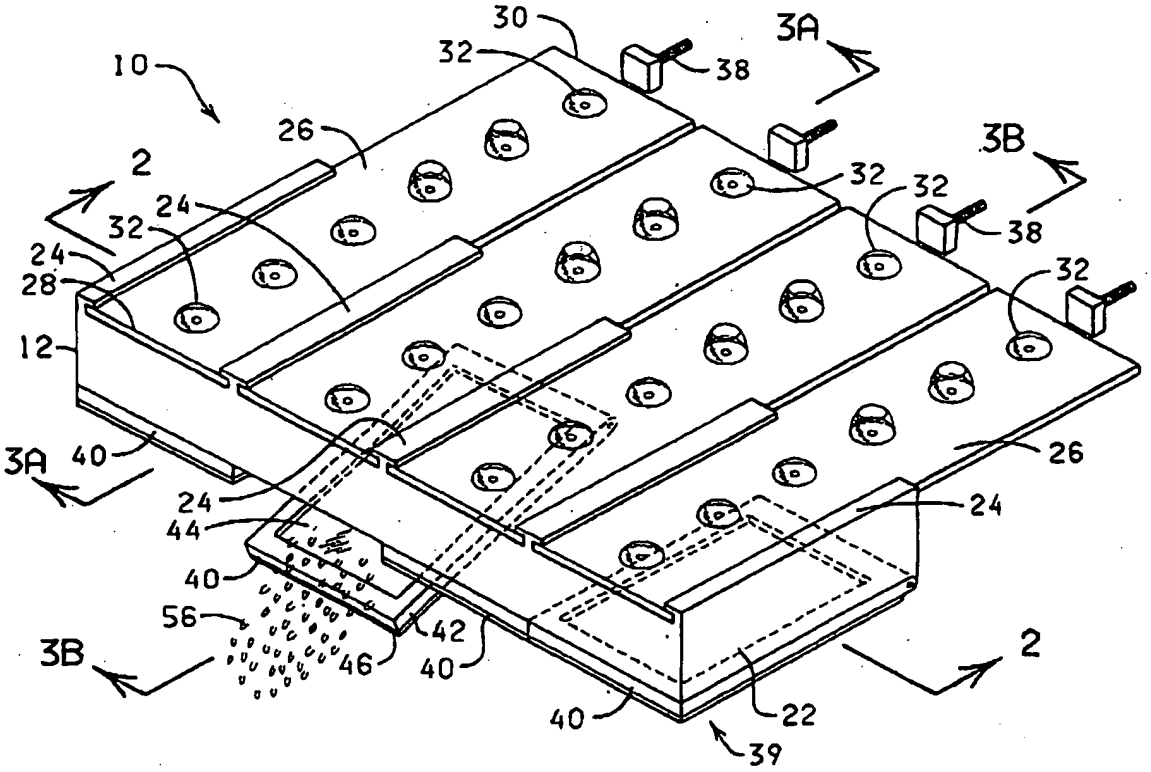
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FIG. 1

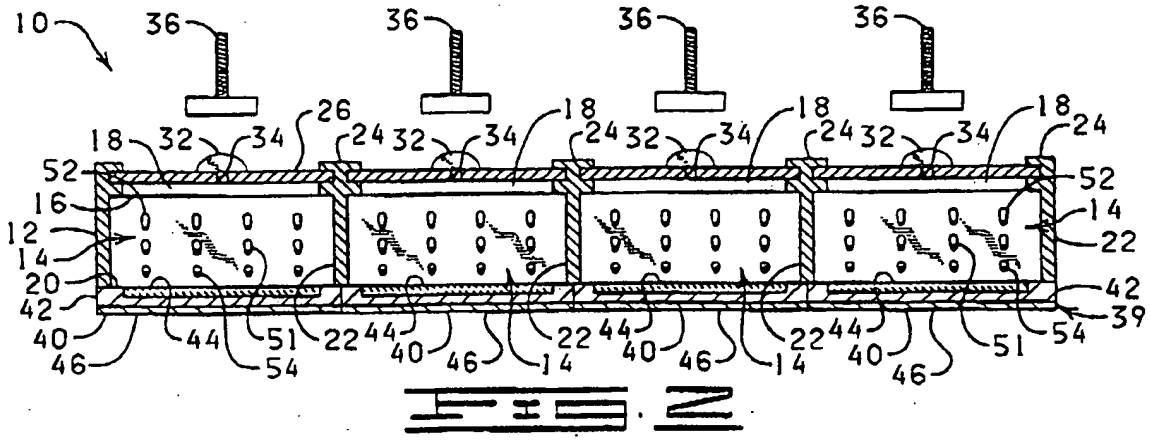
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FIG. 2

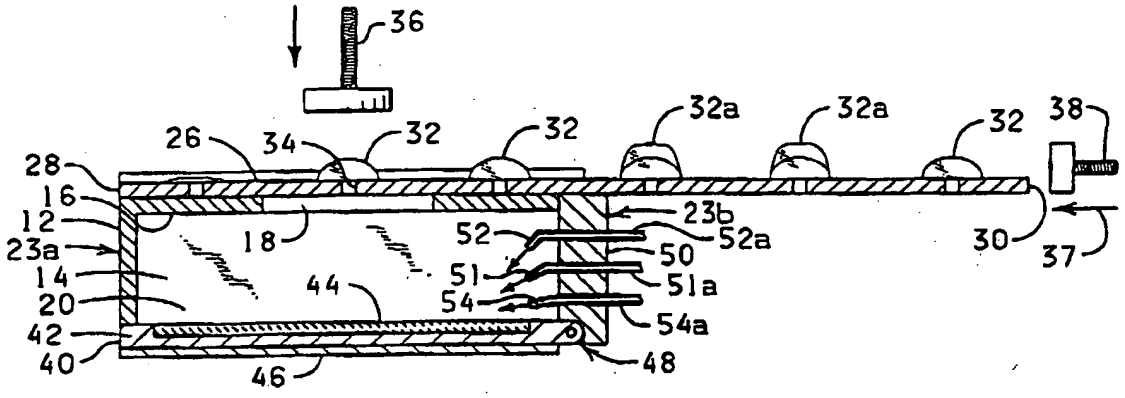
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FIG. 3A

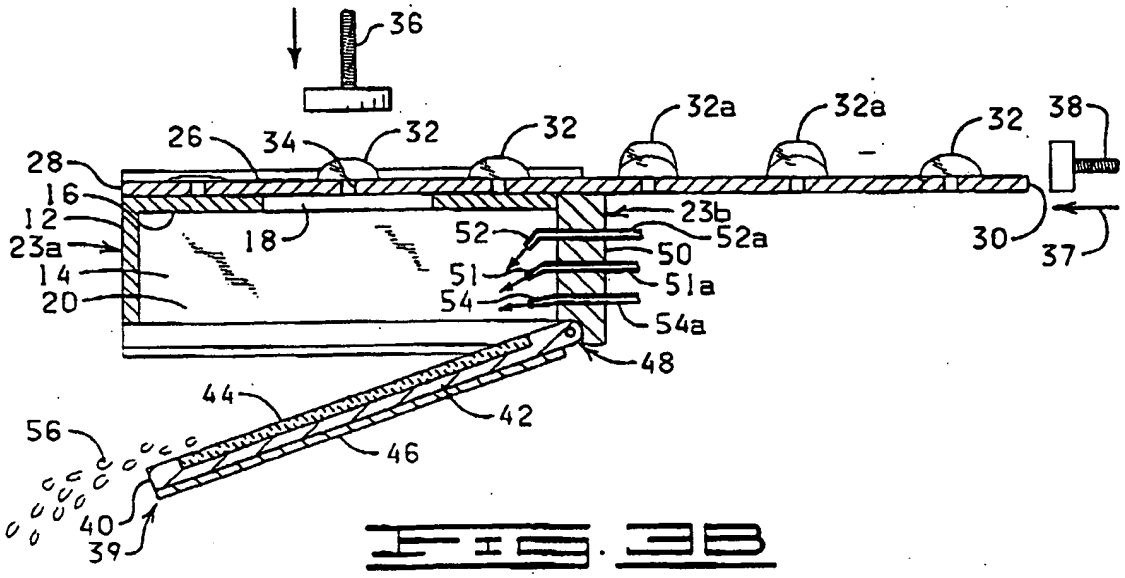
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FIG. 3B

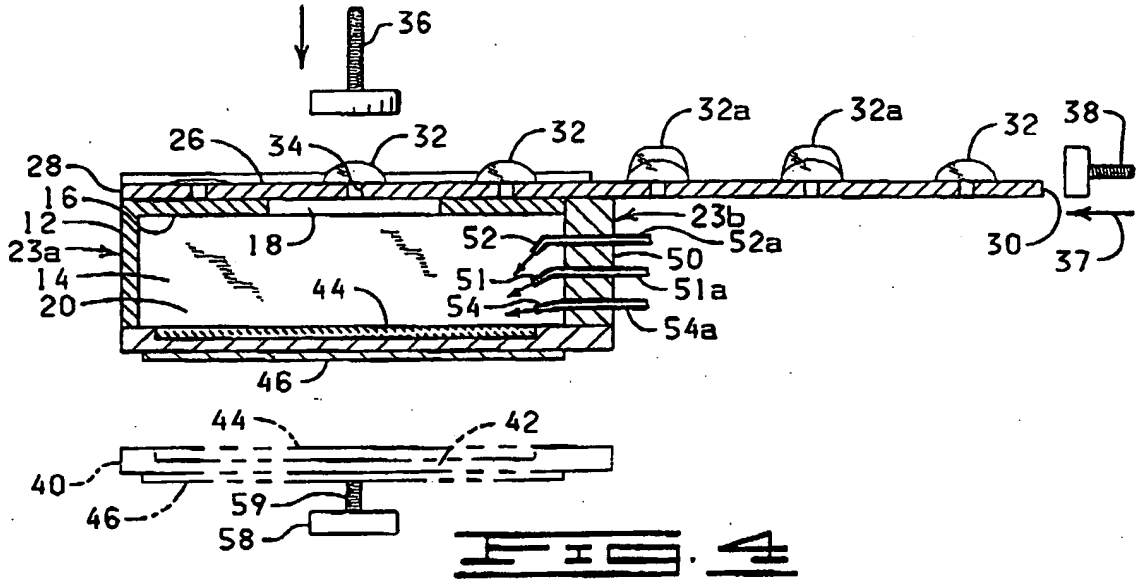

FIG. 4

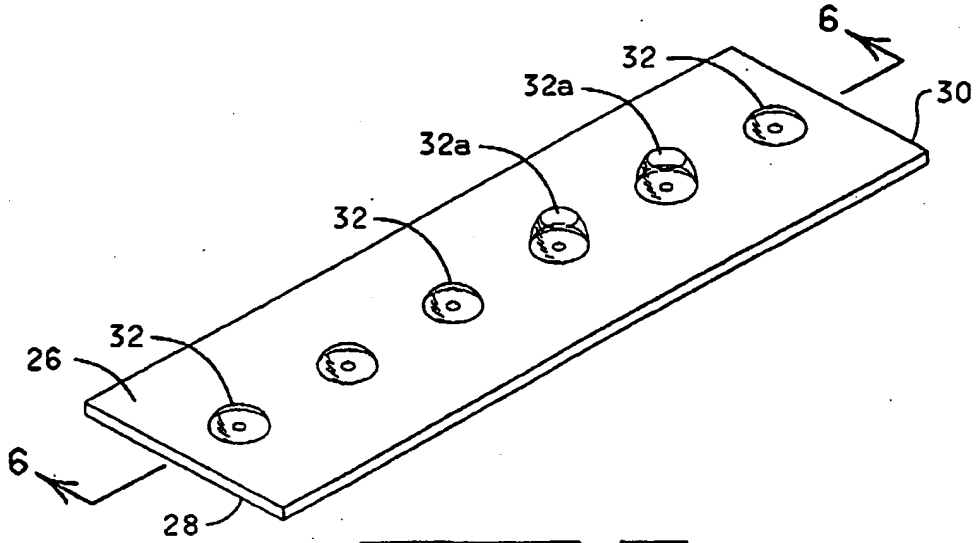

FIG. 5

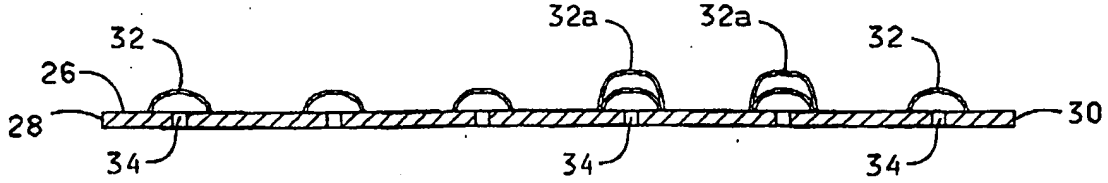

FIG. 6

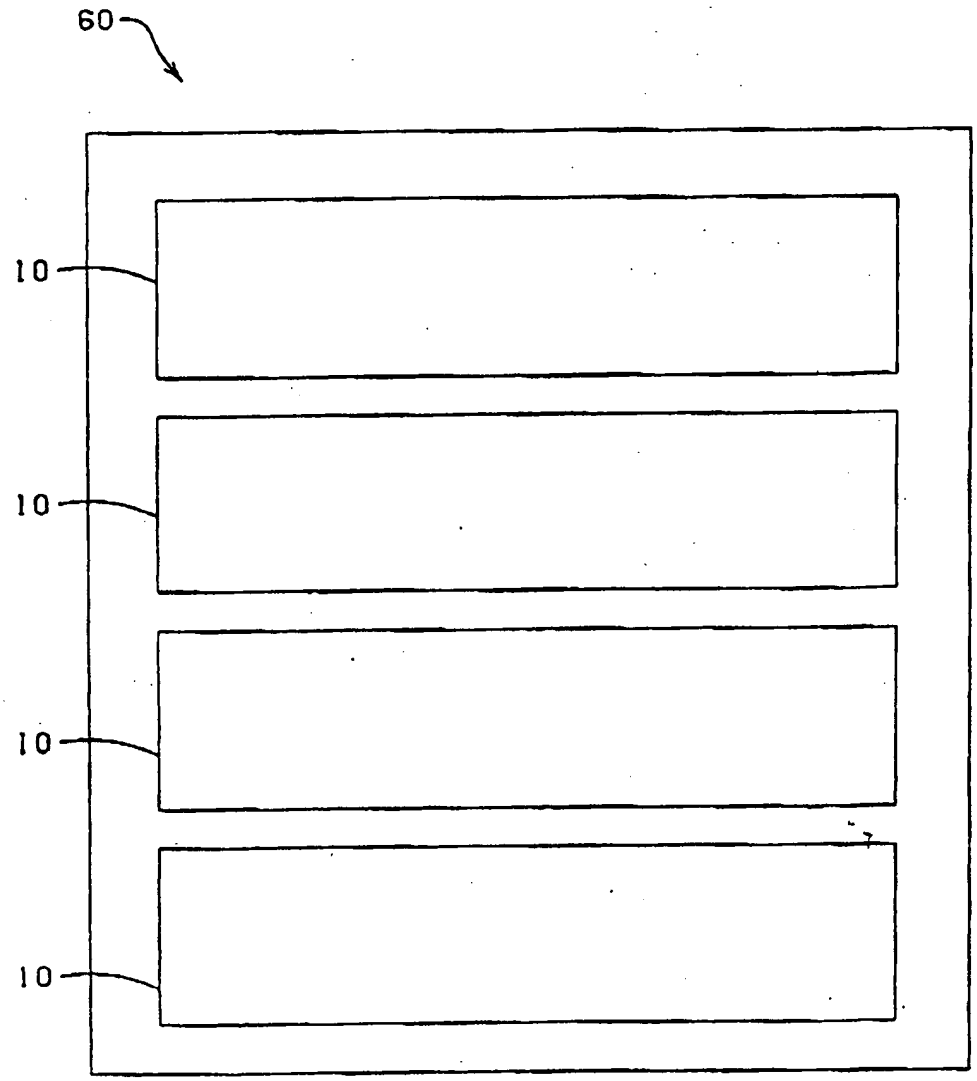

Fig. 7

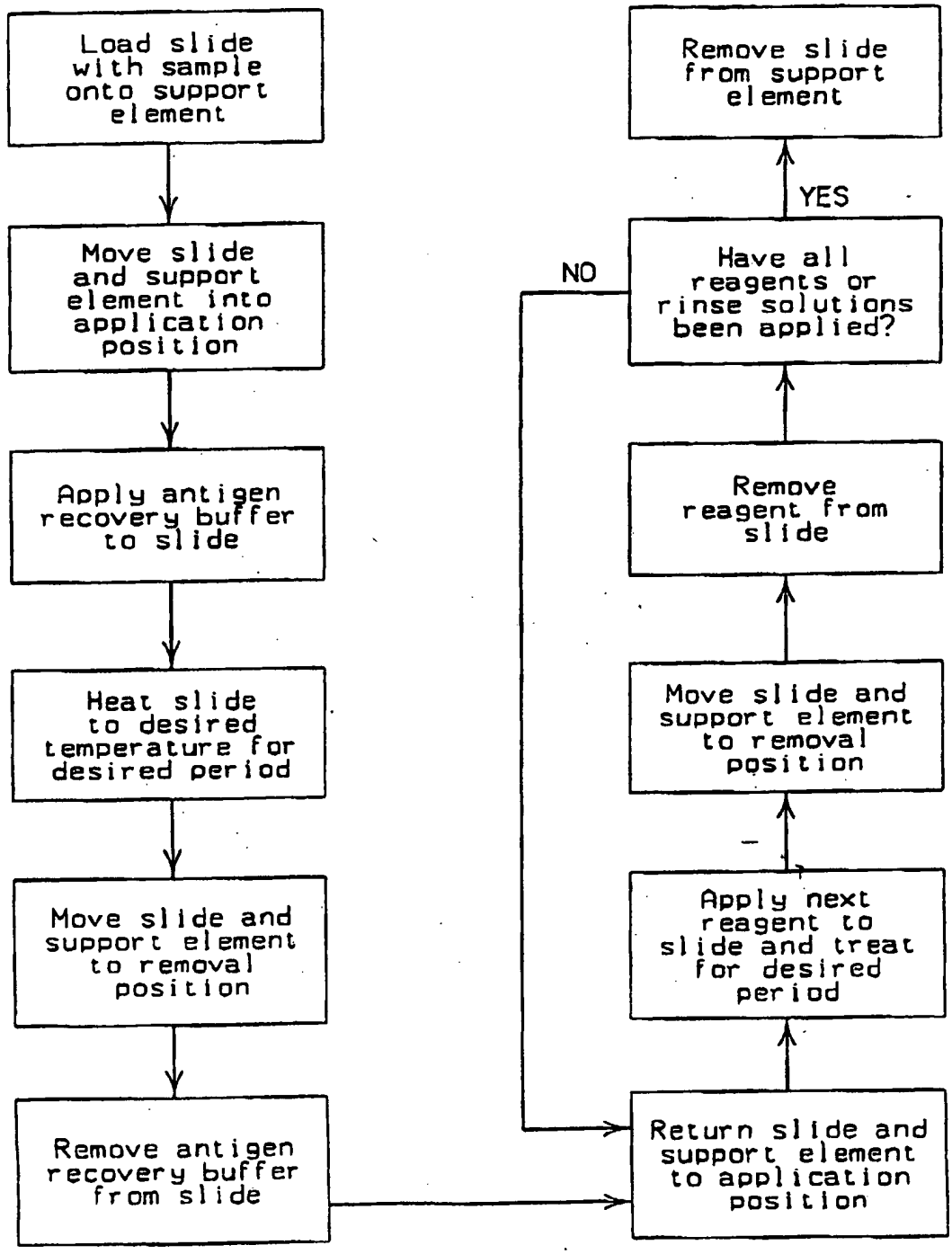
Load slide with sample onto support element
Move slide and support element into application position
Apply antigen recovery buffer to slide
Heat slide to desired temperature for desired period
Move slide and support element to removal position
Remove antigen recovery buffer from slide
Return slide and support element to application position
Apply next reagent to slide and treat for desired period
Move slide and support element to removal position
Remove reagent from slide
Have all reagents or rinse solutions been applied?
NO
YES
Remove slide from support element

FIG. 8